US008186197B2

(12) **United States Patent**
Walle

(10) **Patent No.: US 8,186,197 B2**
(45) **Date of Patent: May 29, 2012**

(54) **ADJUSTABLE FLANGE FORMING APPARATUS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 937 days.

(21) Appl. No.: **11/940,442**

(22) Filed: **Nov. 15, 2007**

(65) **Prior Publication Data**

US 2008/0115550 A1 May 22, 2008

Related U.S. Application Data

(60) Provisional application No. 60/866,156, filed on Nov. 16, 2006.

(51) **Int. Cl.**
B21D 5/08 (2006.01)
B21B 31/16 (2006.01)

(52) **U.S. Cl.** **72/181**; 72/176; 72/247

(58) **Field of Classification Search** 72/176, 72/179, 180–182, 247, 446, 447, 454
See application file for complete search history.

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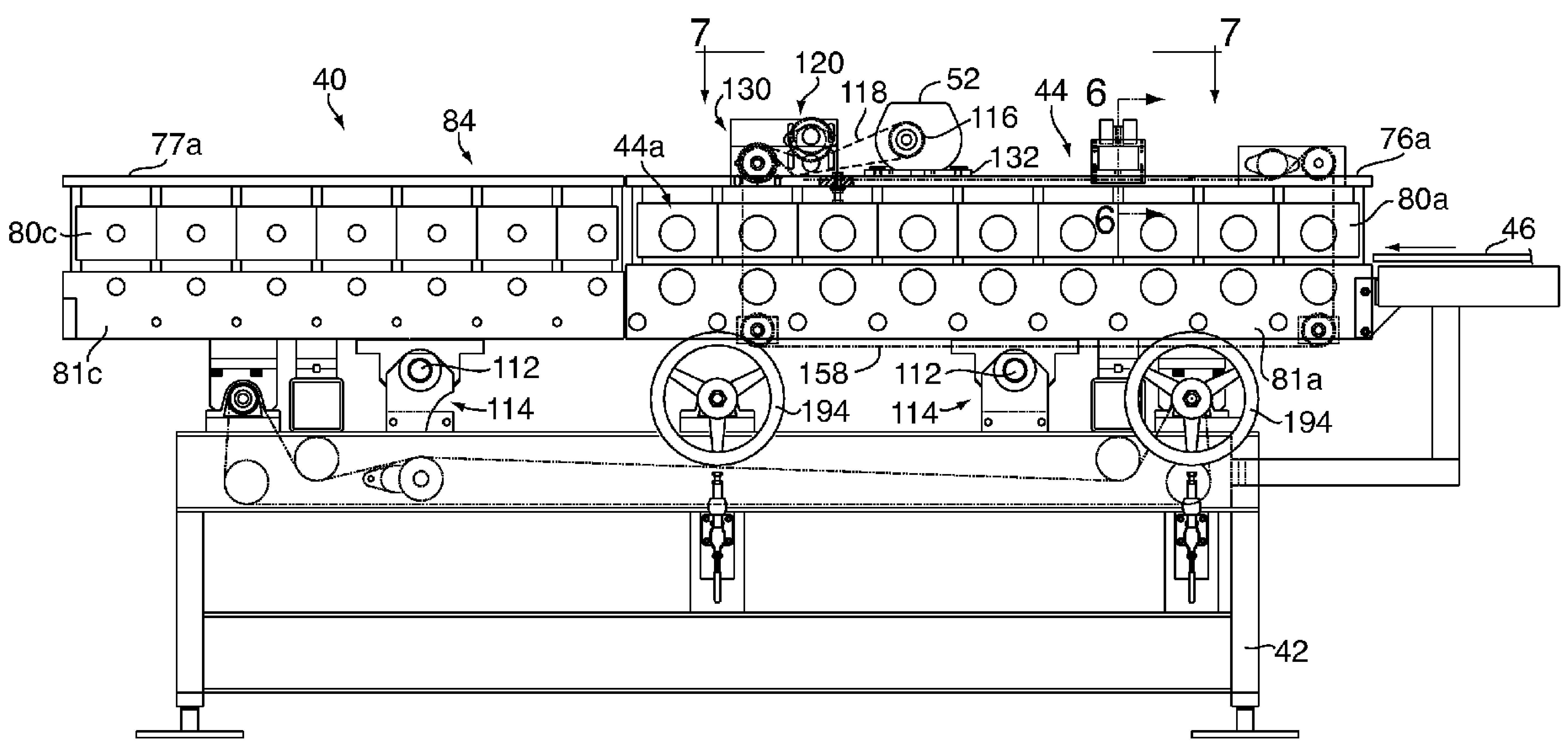
(57) **ABSTRACT**

A flange-forming apparatus allows a user to automatically adjust the device's roll forming stations, concurrently together, for changing the height of a flange formed into a metal web by the roll forming stations, e.g., for ductwork. The height is adjustable within an infinite range between set maximum and minimum limits. Each roll forming station includes upper and lower roll forming pairs, which cooperate for forming the flange or portion thereof. Each roll forming pair includes a first roll forming portion, and a second, coaxial roll forming portion that is axially moveable towards and away from the first roll forming portion. (The portions are in effect a laterally split roll forming die.) The second roll forming portions are rotatably supported on a plate-like adjustment linkage assembly, which can be shifted, using an array of motor driven screw members, towards or away from the first roll forming portions.

20 Claims, 9 Drawing Sheets



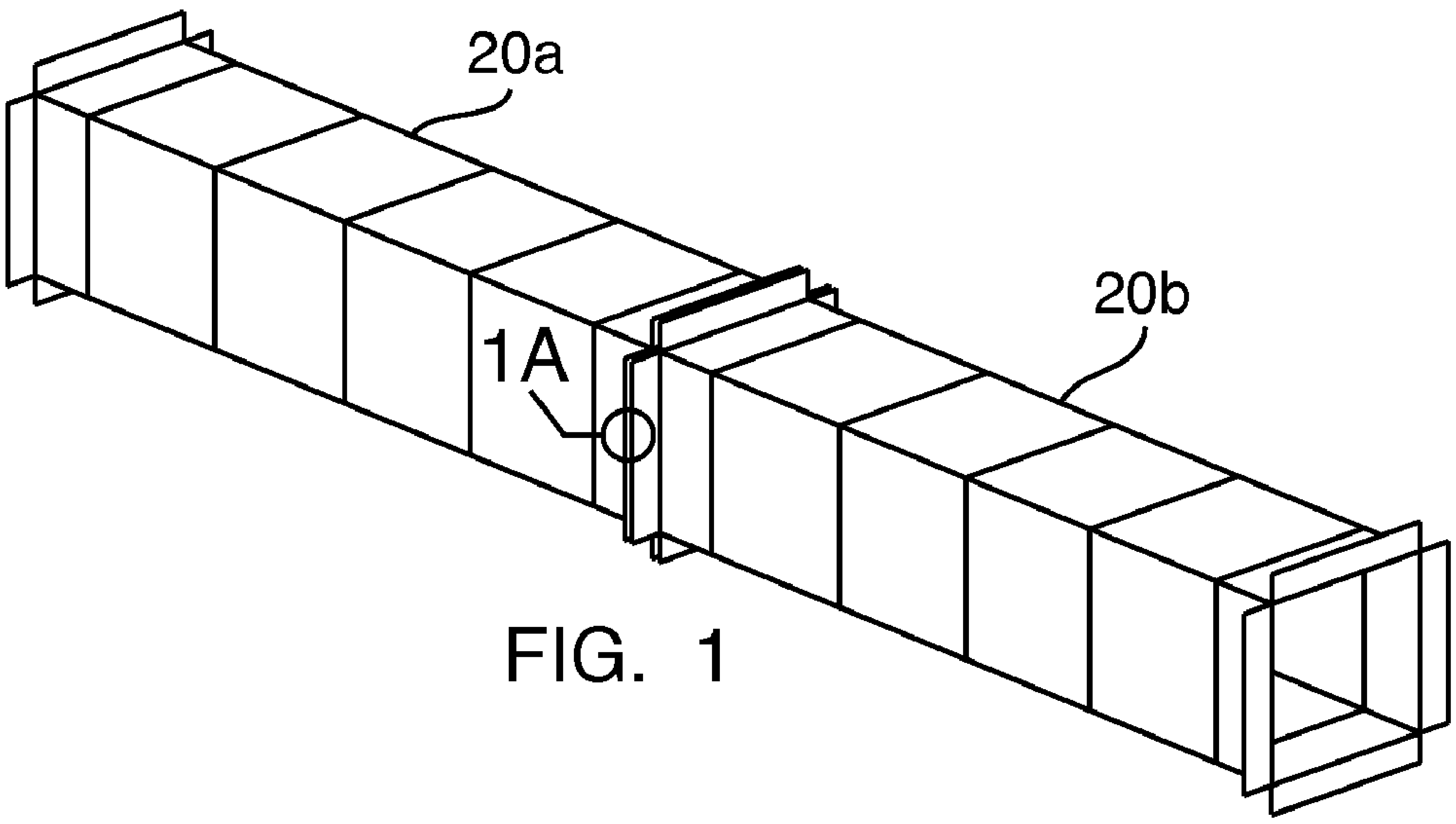


FIG. 1

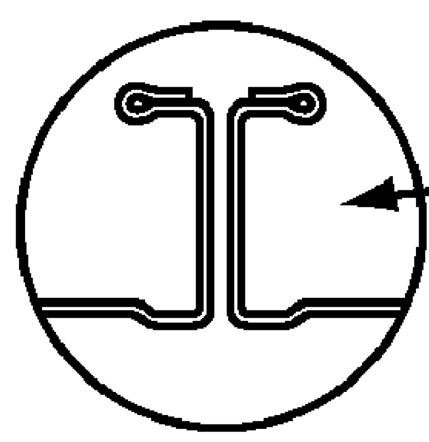


FIG. 1A

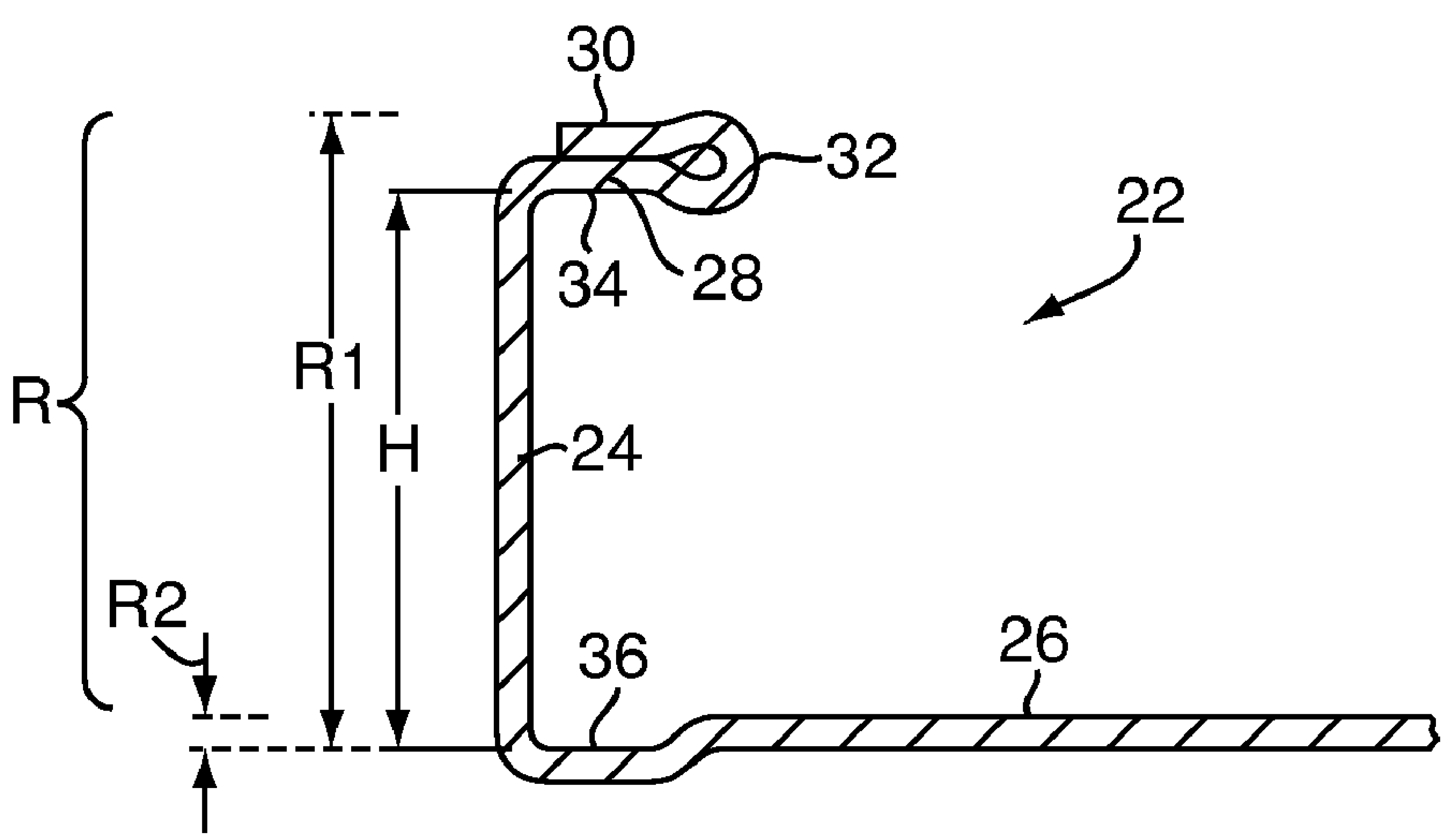


FIG. 1B

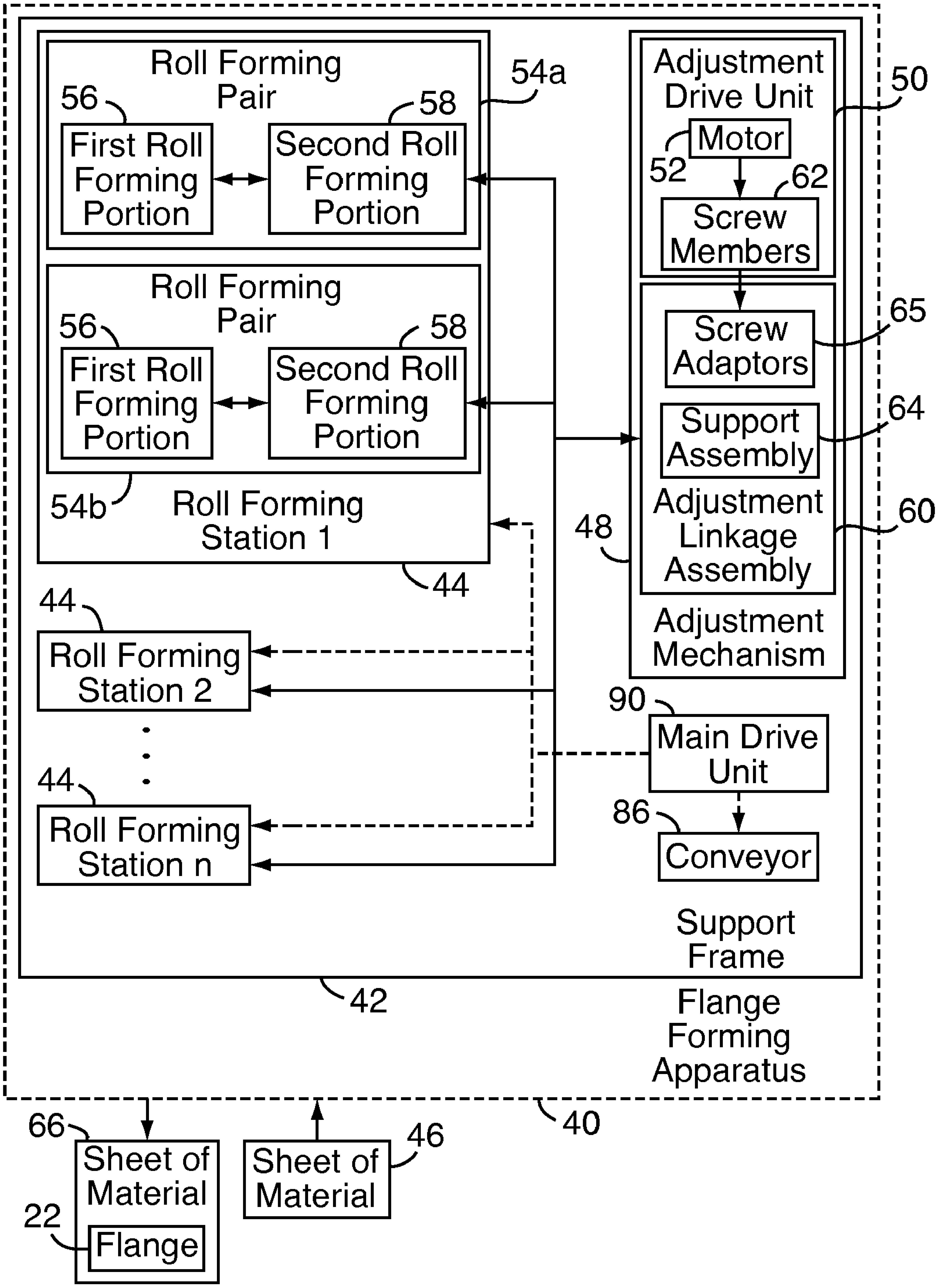
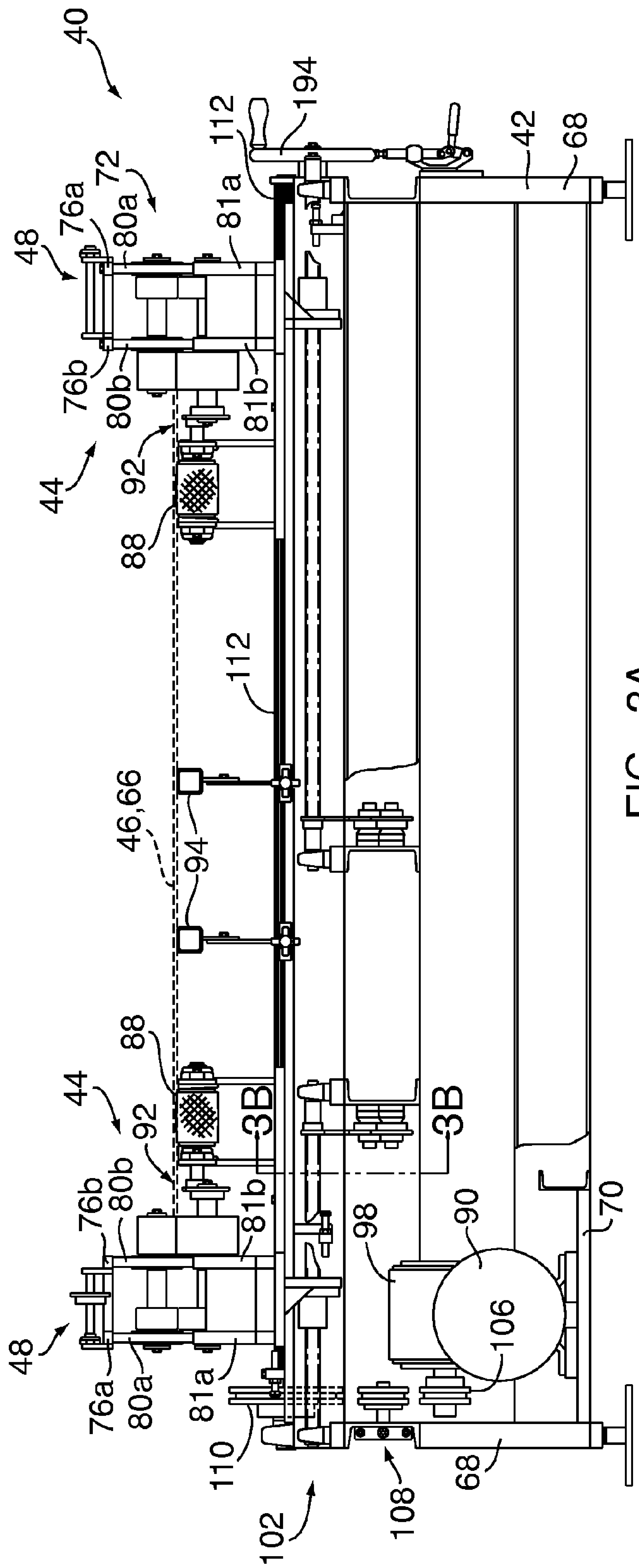

Roll Forming Pair
56
58
First Roll Forming Portion
Second Roll Forming Portion
54a
Roll Forming Pair
56
58
First Roll Forming Portion
Second Roll Forming Portion
54b
Roll Forming Station 1
44
44
Roll Forming Station 2
44
Roll Forming Station n
Adjustment Drive Unit
50
Motor
52
62
Screw Members
Screw Adaptors
65
Support Assembly
64
Adjustment Linkage Assembly
60
48
Adjustment Mechanism
90
Main Drive Unit
86
Conveyor
Support Frame
42
Flange Forming Apparatus
40
66
Sheet of Material
22
Flange
Sheet of Material
46

FIG. 2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194
112
42
68
72
76a
80a
48
81a
76b
80b
81b
44
92
88
112
46,66
94
3B
3B
98
90
106
70
110
102
108
68

FIG. 3A

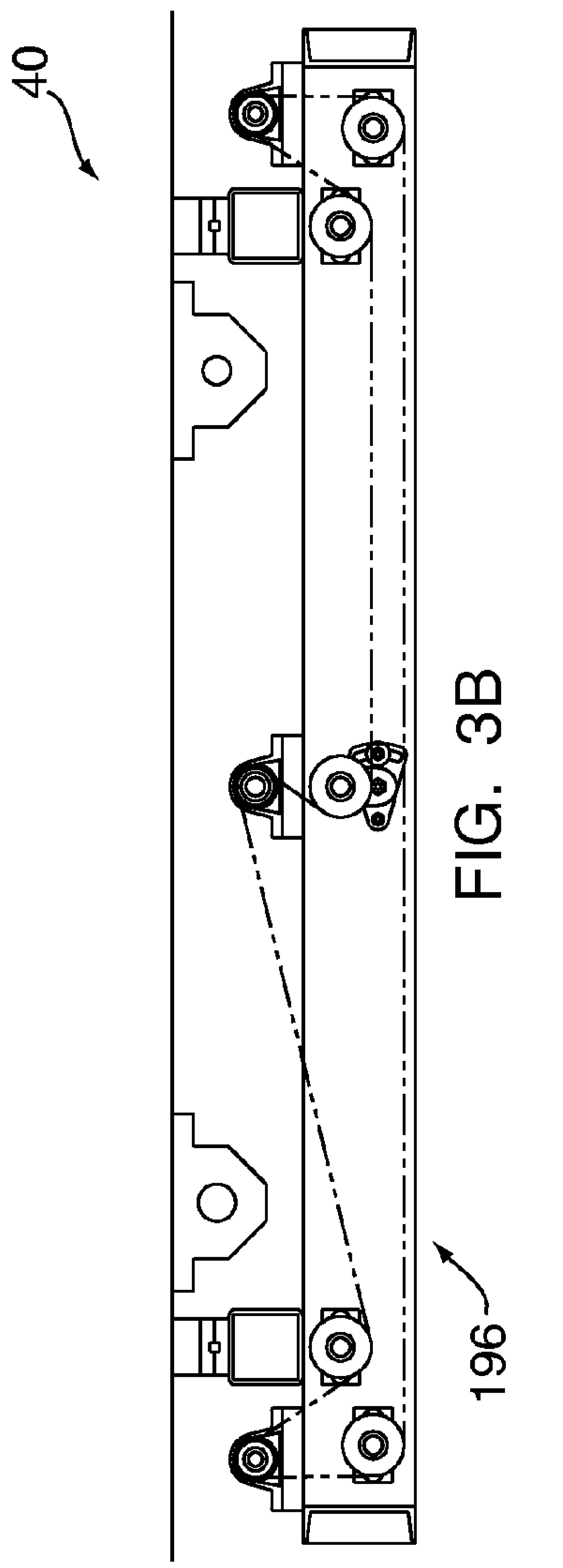
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FIG. 3B

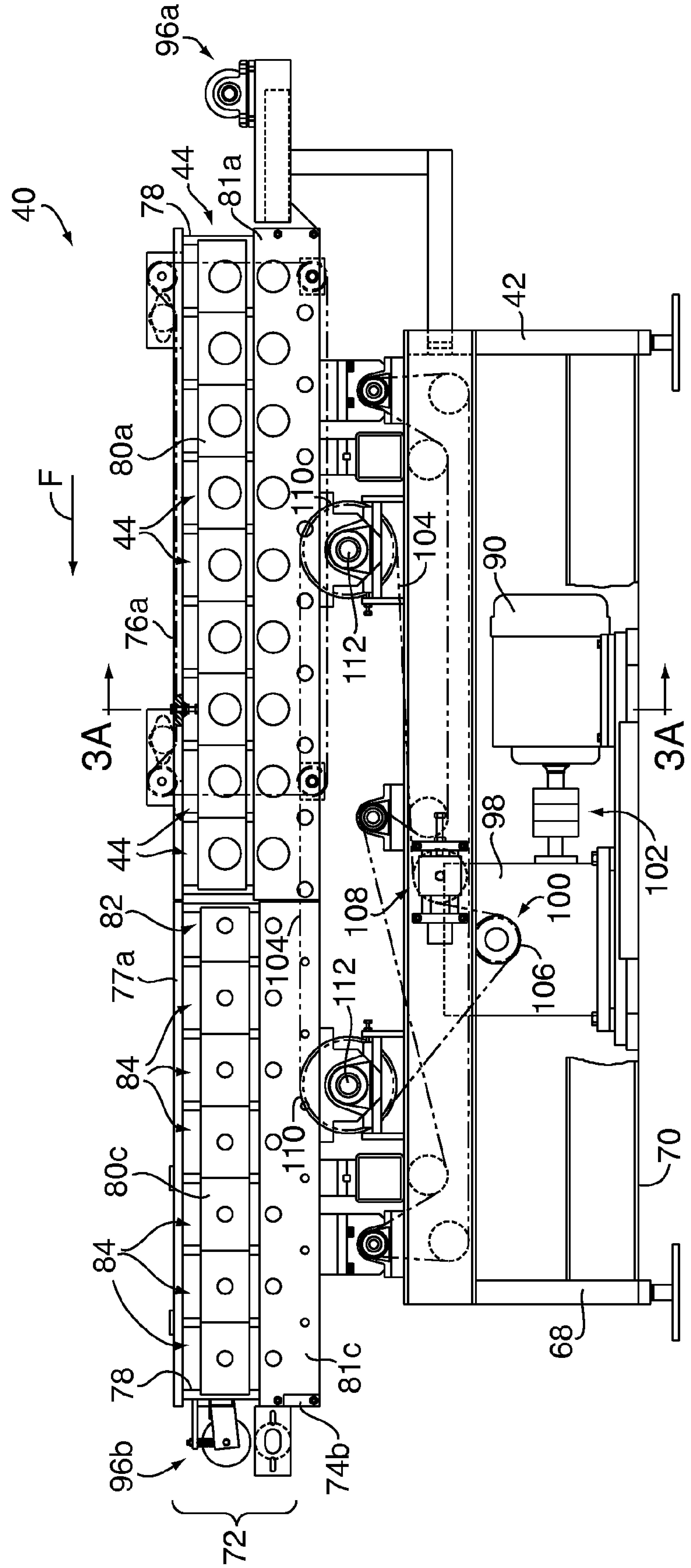

96a
40
78
44
81a
42
80a
F
44
110
104
90
76a
112
3A
3A
98
102
44
82
108
100
77a
104
112
106
84
110
80c
84
70
68
78
81c
96b
74b
72

FIG. 4

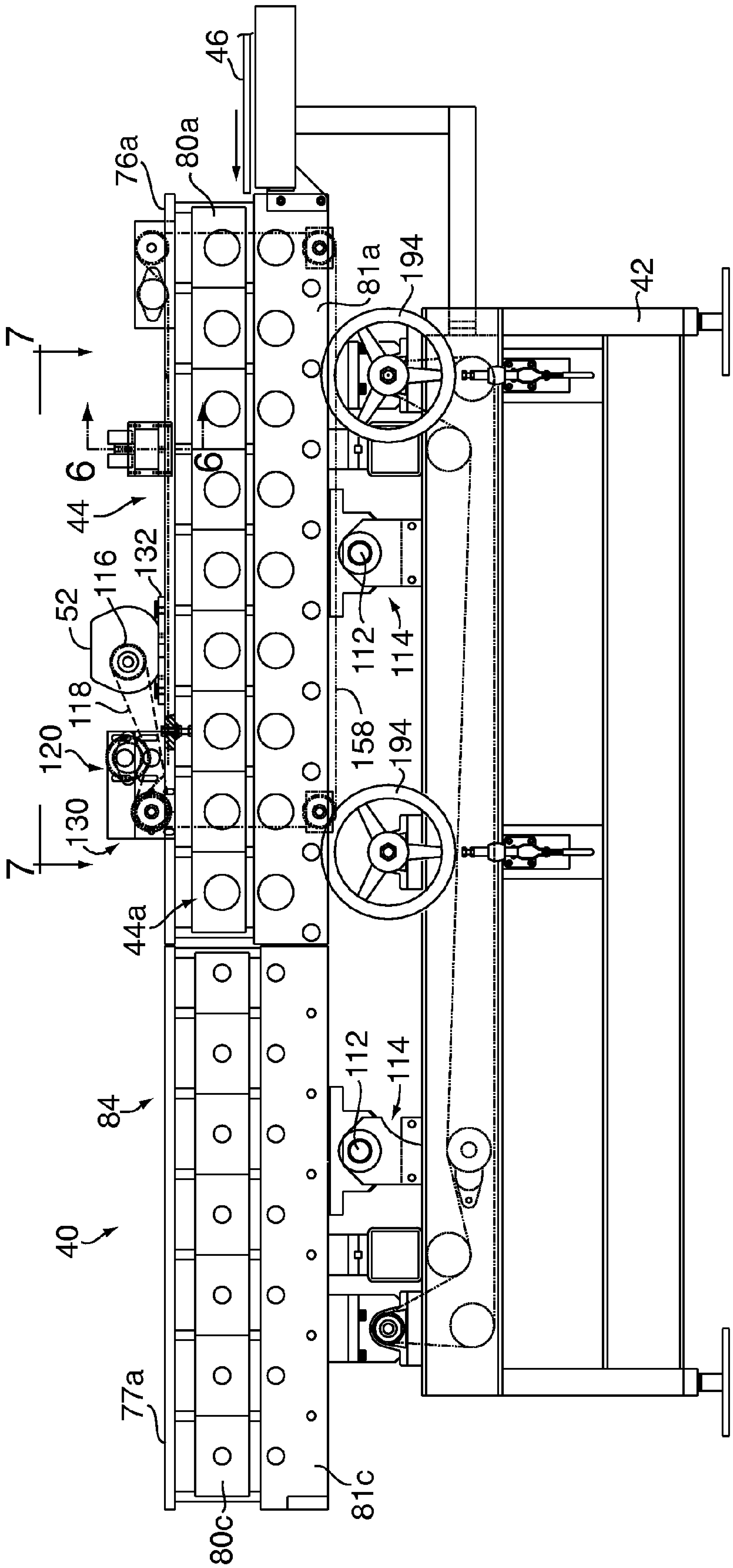

46
76a
80a
7
6
44
52
116
132
118
120
130
7
44a
81a
194
42
6
112
114
158
194
84
40
112
114
77a
80c
81c

FIG. 5

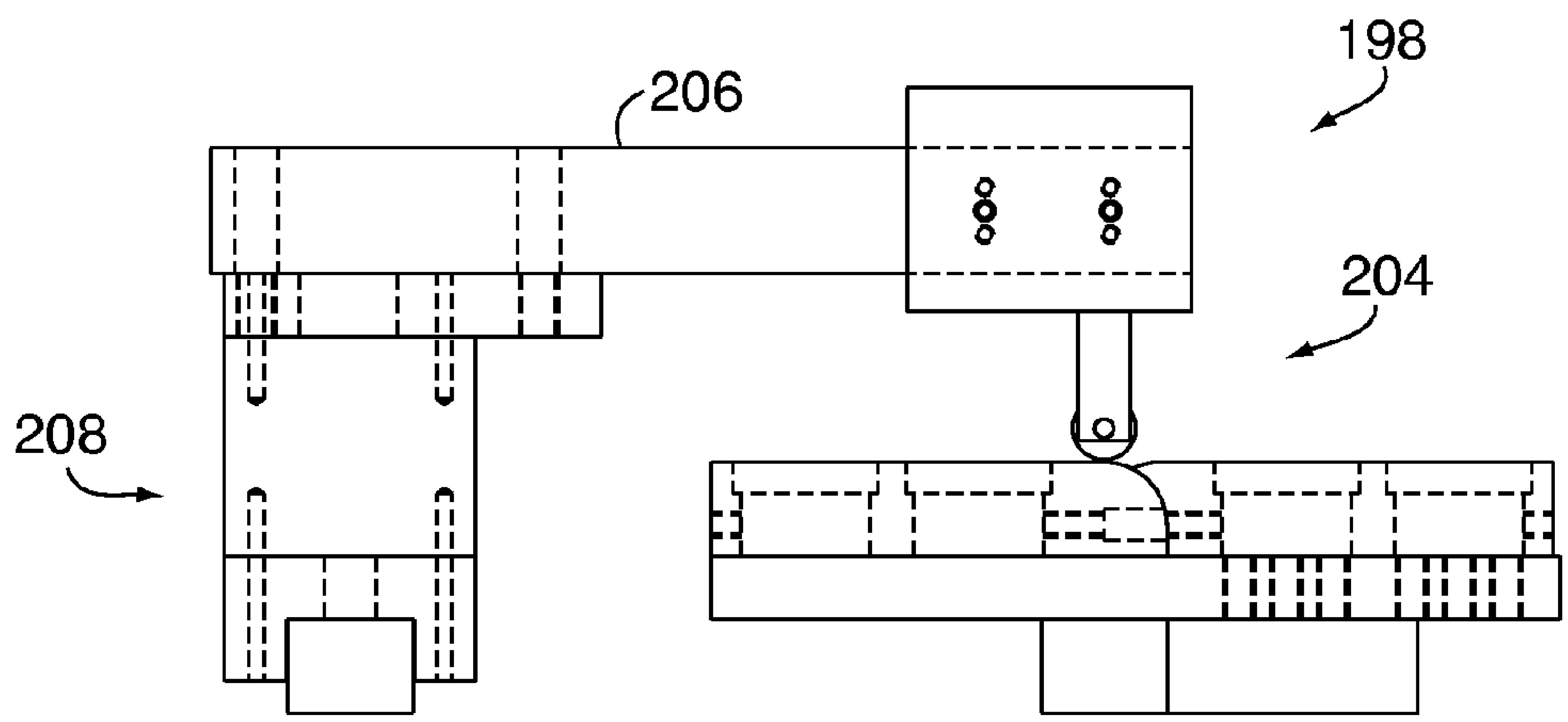
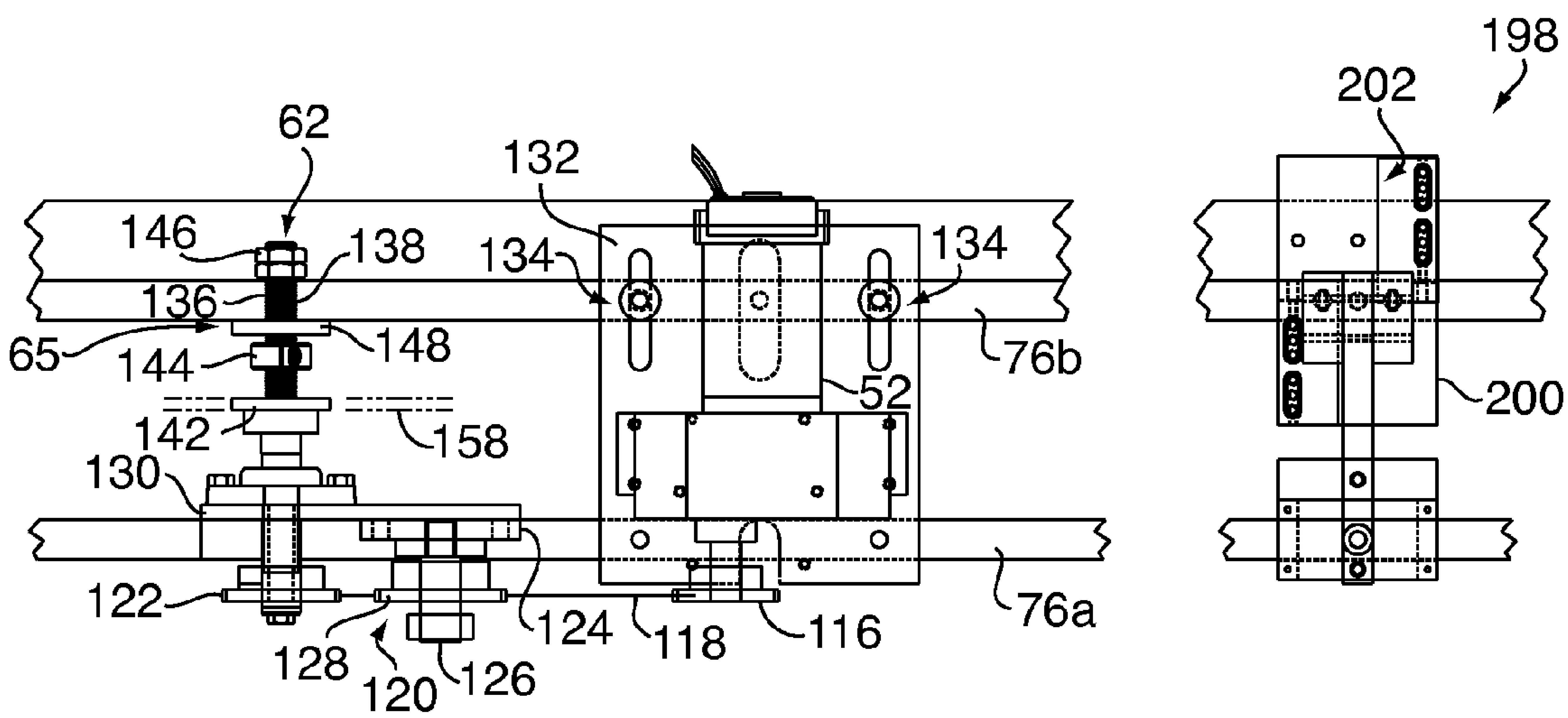

198
206
204
208

FIG. 6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146
138
136
65
148
144
142
158
130
122
128
120
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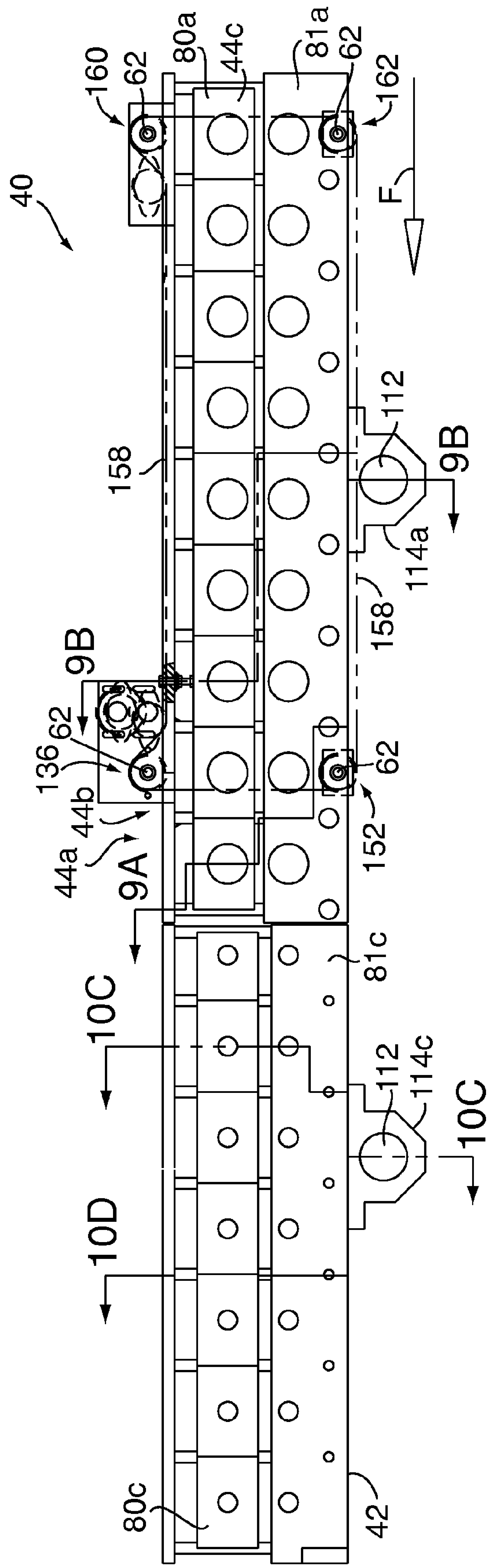
124
118
116
76a
76b
52
132
134
134
198
202
200

FIG. 7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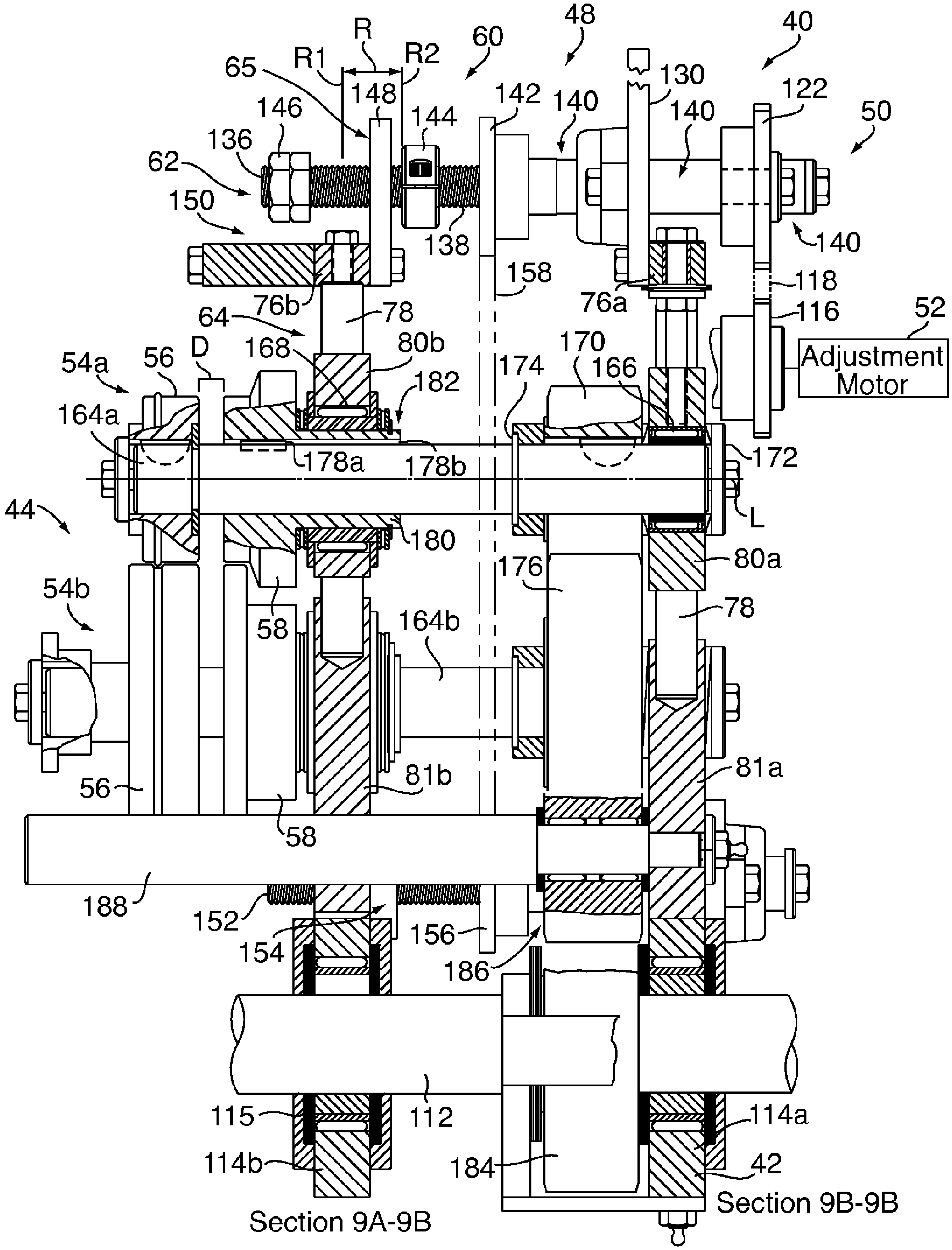
160
62
80a
44c
81a
62
162
F
158
112
9B
114a
158
9B
62
136
44b
44a
9A
62
152
81c
10C
112
114c
10C
10D
80c
42

FIG. 8



R
R1
R2
60
48
40
65
148
130
122
146
144
142
140
140
50
136
62
150
138
140
158
118
76a
76b
78
116
52
64
Adjustment Motor
168
80b
174
170
166
54a
56
D
182
164a
178a
178b
172
L
44
180
80a
176
54b
58
164b
78
81a
81b
56
58
188
152
156
154
186
115
112
114a
114b
184
42
Section 9A-9B
Section 9B-9B

FIG. 9

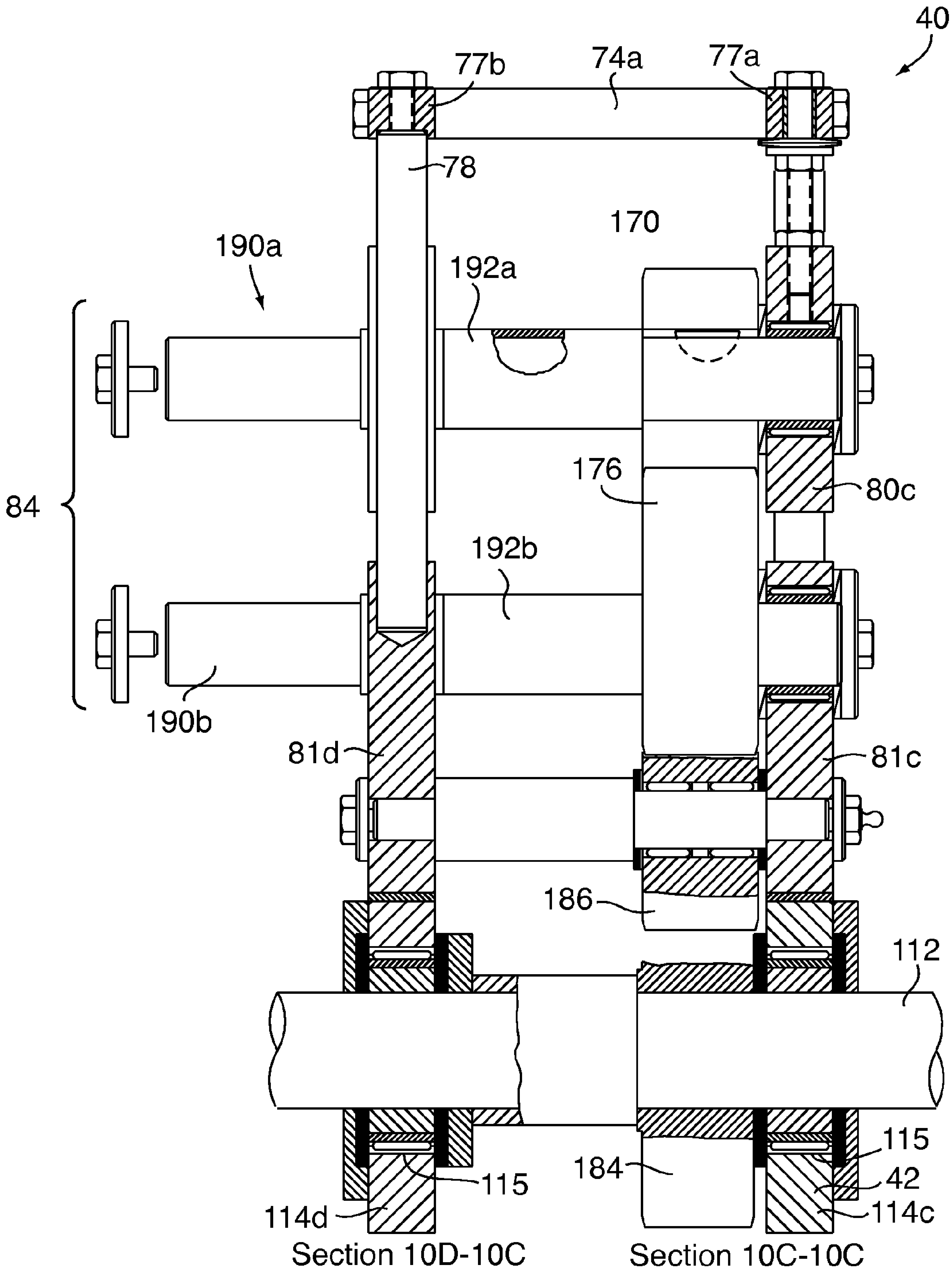

40
77b
74a
77a
78
170
190a
192a
84
176
80c
192b
190b
81d
81c
186
112
115
184
115
42
114d
114c
Section 10D-10C
Section 10C-10C

FIG. 10

ADJUSTABLE FLANGE FORMING APPARATUS

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application Ser. No. 60/866,156, filed Nov. 16, 2006, incorporated by reference herein in its entirety.

FIELD OF THE INVENTION

The present invention relates to machine tools and, more particularly, to devices for forming flanges in metal ductwork.

BACKGROUND OF THE INVENTION

With reference to FIGS. **1**, **1**A, and **1**B, for connecting longitudinally adjacent, end-on-end sections **20***a*, **20***b* of rectangular, metal ductwork together, each end of the duct section **20***a*, **20***b* is typically provided with an integral transverse flange **22**, such as a TDC® flange or a TDF® flange. Transverse flanges can be configured in different manners. In the example shown in FIGS. **1**A and **1**B, the flange **22** includes an upturned portion **24** extending perpendicularly outwards from the duct wall **26**. A rearwardly bent portion **28**, integral with the upturned portion **24** and lying generally perpendicular thereto, extends rearwards opposite the duct wall. A forewardly extending return portion **30** is integrally connected to the rearwardly bent portion **28**, and is connected thereto by way of a rounded bead portion **32**. A channel **34** is formed between the bead **32** and the upturned portion **24**, and a similar channel **36** is formed in the duct wall opposite the channel **34**, between the upturned portion **24** and the duct wall **26**. (The channels **34**, **36** accommodate a corner-type connector, not shown.) Further information about transverse flanges can be found, for example, in U.S. Pat. No. 4,466,641, dated Aug. 21, 1984, and in U.S. Pat. No. 6,547,287, dated Oct. 11, 2001, which also describe how the flanges are used to connect sections of duct together.

Instead of cutting, assembling, and installing a separate flange onto the ductwork, transverse flanges are typically roll formed directly onto the duct. For doing so, the edge of the metal sheeting used to form the duct is subjected to one or more roll forming operations that bend or otherwise manipulate the metal sheeting according to the desired flange configuration. The roll forming operations are carried out using a roll-forming apparatus or machine. The roll-forming machine includes a number of successively arrayed stations. As the metal sheet is passed through the roll-forming machine, each station manipulates the metal sheet according to its particular configuration.

Because roll forming operations involve the manipulation of metal sheeting, a roll-forming machine must be heavy duty, robust, and resistant to the misalignment and maladjustment of its parts. Accordingly, roll-forming machines are typically configured to produce only one type or configuration of flange, with set dimensions. If another type of flange is to be produced, or the same type of flange but with different dimensions, the machine must be manually re-tooled. For doing so, for each station, various plates and other outer portions are removed to access the station. Then, various rings, retainers, and other connectors are removed to access the tool, the tool is replaced with a new tool, and the retaining and cover portions are reattached to the device. Some roll-forming machines have been proposed for allowing the roll forming stations to be adjusted in a limited manner, but these have

been based on air cylinders or hydraulic cylinders, which lack the positive location required for accurate, repetitive roll-forming operations in an industrial setting.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a flange-forming device or apparatus that allows a user to automatically adjust the device's roll forming stations, concurrently together, as relating to one or more operational characteristics of the stations for producing a flange in a sheet or web of metal or other material. For example, in one embodiment, the roll forming stations are concurrently adjustable for changing a height of the flange within an infinite range between set maximum and minimum limits.

To achieve this and other objects, an embodiment of the present invention relates to a flange forming apparatus that includes a support frame, and a number of roll forming stations carried on the support frame for forming a flange in a sheet or web of material. Each roll forming station is adjustable as relating to a dimensional characteristic of the flange to be produced or operated upon by the station, e.g., flange height. The apparatus includes an adjustment mechanism, operably connected to the roll forming stations, for adjusting the roll forming stations concurrently together. (By "concurrent" adjustment, it is meant that operation of an adjustment drive unit, e.g., a motor or hand crank, causes the roll forming stations to be adjusted at the same time, without the need for any manual interaction with the roll forming stations, such as tool changeover.)

In another embodiment, the roll forming stations are infinitely adjustable within a set range defined by maximum and minimum values for the flange dimensional characteristic(s), e.g., flange height. Operation of the adjustment mechanism causes the roll forming stations to be infinitely adjusted within the set range. ("Infinite" adjustment refers to adjustment without set or predefined values within the maximum and minimum limits.)

In another embodiment, each roll forming station includes one or more roll forming pairs. (Most typically, each station will include upper and lower roll forming pairs, which cooperate for forming the flange or some portion thereof.) Each roll forming pair includes a first roll forming portion and a second roll forming portion that is coaxial with the first roll forming portion and axially moveable towards and away from the first roll forming portion. (The two roll forming portions are in effect a laterally split roll forming die, where the distance between the split portions is adjustable.) The adjustment mechanism includes an adjustment drive unit, e.g., a motor or hand crank and related structure, and an adjustment linkage assembly. The adjustment linkage assembly rotatably supports the second roll forming portions, and establishes their respective axial positions, i.e., when the linkage assembly is moved or shifted, the second roll forming portions move along with the linkage assembly, while remaining rotatable with respect thereto. When the adjustment drive unit is operated, this shifts the adjustment linkage assembly, thereby shifting the second roll forming portions towards or away from the first roll forming portions. The adjustable distance between the first and second roll forming portions is proportional to the height of the flange produced by the apparatus.

In another embodiment, the adjustment drive unit includes an adjustment drive motor and a screw member, and the adjustment linkage assembly includes a screw adaptor threaded on the screw member and a bearing support subassembly attached to the screw adaptor. (Typically, there will be more than one screw member and screw adaptor.) The bearing support sub-assembly rotatably supports the second roll forming portions. In operation, when the screw member is caused to rotate by the adjustment drive motor, the screw adaptor, prevented from rotating because of the connection between the bearing support sub-assembly and the second roll forming portions or otherwise, is shifted along the length of the screw member. This shifts the bearing support sub-assembly and thereby the second roll forming portions towards or away from the first roll forming portions. Use of a screw member and screw adaptor facilitates infinite adjustment of the spacing between the first and second roll forming portions, and provides for an accurate yet adjustable positioning of the second roll forming portions, e.g., after being positioned, the second roll forming portions are resistant to unwanted axial movement resulting from machine vibration or the like.

In another embodiment, each roll forming pair (e.g., the first and second portions of the split roll forming die) is carried on a rotating spindle, which is directly or indirectly driven by the main motor or other drive unit of the flange forming apparatus. The first roll forming portion is fixed to the spindle. The second roll forming portion is moveable along at least part of the spindle, e.g., as defined by a key slot formed in the spindle or in the second roll forming portion and a key attached to the other one of the spindle or the second roll forming portion. The bearing support sub-assembly rotatably supports the spindle and second roll forming portion. Movement of the adjustment linkage assembly, through actuation of the adjustment drive unit, causes the second roll forming portion to move axially along the spindle.

In another embodiment, in the case where the flange forming apparatus includes a number of screw members, the screw members may be interconnected by a chain drive. Here, actuation (e.g., rotation) of one of the screw members, or the chain drive directly, by the adjustment drive motor causes all the screw members to rotate in concert.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be better understood from reading the following description of non-limiting embodiments, with reference to the attached drawings, wherein below:

FIG. **1** is a perspective view of two sections of metal ductwork, arrayed end-on-end for connection thereof;

FIGS. **1**A and **1**B are cross section views of a transverse flange formed in each of the ductwork sections;

FIG. **2** is a partial schematic view of a flange forming device or apparatus according to an embodiment of the present invention;

FIG. **3**A is a lateral cross section view of the flange forming apparatus, taken along line **3**A-**3**A in FIG. **4** or thereabouts;

FIG. **3**B is a cross section view of part of the flange forming apparatus, taken along line **3**B-**3**B in FIG. **3**A;

FIG. **4** is a first side elevation view of the flange forming apparatus;

FIG. **5** is a second side elevation view of the flange forming apparatus;

FIG. **6** is a cross section view of a limit switch mount portion of the flange forming apparatus shown in FIG. **5**, taken along line **6-6** in FIG. **5**;

FIG. **7** is a top plan view of part of the flange forming apparatus shown in FIG. **5**, taken along line **7-7** in FIG. **5**;

FIG. **8** is a third side elevation view of the flange forming apparatus;

FIG. **9** is a lateral cross section view of part of the flange forming apparatus in FIG. **8**, taken along line **9**B-**9**B and line **9**A-**9**B in FIG. **8**; and

FIG. **10** is a second lateral cross section view of the flange forming apparatus in FIG. **8**, taken along line **10**D-**10**C and line **10**C-**10**C in FIG. **8**.

DETAILED DESCRIPTION

In overview, with reference to FIGS. **1-10**, a flange forming device or apparatus **40** includes a support frame **42** and a number of adjustable roll forming stations **44** carried on the support frame **42** for forming a flange **22** in a sheet or web of material **46**. Each roll forming station **44** is infinitely adjustable as relating to a dimensional characteristic of the flange to be produced or operated upon by the station, e.g., flange height "H," within a set range "R" defined by maximum and minimum values "R**1**," "R**2**," respectively, for the flange height or other dimensional characteristic(s). (One example of a typical height range is 19 to 40 mm.) The device includes an adjustment mechanism **48**, operably connected to the roll forming stations **44**, for infinitely adjusting the roll forming stations **44** concurrently together. Thus, in operation, actuation of an adjustment drive unit **50**, which includes an adjustment motor **52** or hand crank, causes the roll forming stations **44** to be adjusted at the same time, without the need for any manual interaction with the roll forming stations.

Typically, each of the adjustable roll forming stations **44** will include upper and lower roll forming pairs **54***a*, **54***b*, which cooperate for carrying out one of the successive forming operations used to form the flange **22**. (For example, the first station might form an initial bend or formation in the web **46**, with subsequent stations further bending or otherwise manipulating the web to form the flange **22** at the output of the apparatus **40**.) Each roll forming pair **54***a*, **54***b* includes a first roll forming portion **56**, e.g., a roll forming die or portion thereof, and a second roll forming portion **58** coaxial with the first roll forming portion (see, e.g., axis "L" in FIG. **9**) and axially moveable towards and away from the first roll forming portion **56**. The adjustment mechanism **48** includes the adjustment drive unit **50** and an adjustment linkage assembly **60**. The adjustment linkage assembly **60** rotatably supports the second roll forming portions **58**, and establishes their respective axial positions with respect to the first roll forming portions **56**, i.e., when the adjustment linkage assembly **60** is moved or shifted, the second roll forming portions **58** move along therewith, while remaining rotatable with respect thereto. When the adjustment drive unit **50** is operated, this shifts the adjustment linkage assembly **60**, thereby shifting the second roll forming portions **58** towards or away from the first roll forming portions **56**. The height "H" of the flange produced by the device is proportional to the adjustable distance "D" between the first and second roll forming portions **56**, **58**, i.e., as D increases, H increases.

In one embodiment, the adjustment drive unit **50** includes one or more screw members **62** that are rotatably driven by the adjustment motor **52**. The adjustment linkage assembly **60** includes a bearing support sub-assembly **64** and one or more screw adaptors **65** fixed to the bearing support sub-assembly. The bearing support sub-assembly **64** rotatably supports the second roll forming portions **58**. The screw adaptors **65** are threaded on respective ones of the screw members **62**. In operation, when the screw members **62** are caused to rotate by the adjustment drive motor **52**, the screw adaptors **65** are shifted along the length of the screw members **62**, thereby shifting the bearing support sub-assembly **64** and the second roll forming portions **58** towards or away from the first roll forming portions **56**. As noted above, use of screw members and screw adaptors facilitates infinite adjustment of the spacing between the first and second roll forming portions, and provides for an accurate yet adjustable positioning of the second roll forming portions, e.g., after being positioned, the second roll forming portions are resistant to unwanted axial movement resulting from machine vibration or the like.

The various portions of the flange forming apparatus **40**, and the operation thereof, will now be described in additional detail, with reference to the figures.

FIG. **3**A shows a lateral cross section of the flange forming apparatus **40**, viewed from the perspective of the exit end, that is, the end from which a finished sheet or web of material **66** exits the apparatus. FIG. **4** shows one side of the apparatus. As indicated, the flange forming apparatus **40** includes the support frame assembly **42**, which is a stationary unit that holds and supports certain portions of the apparatus. The support frame **42** includes various support legs **68**, cross and frame members **70**, and the like. A generally rectangular, horizontal bed **72** is positioned atop the support frame. The bed **72** is defined by various structural and other members that include upper and lower lateral spreaders **74***a*, **74***b* (upper spreader **74***a* is shown in FIG. **10**), longitudinal head rails **76***a*, **76***b*, **77***a*, **77***b*, various vertical posts **78**, upper bearing blocks **80***a*-**80***d*, lower bearing blocks **81***a*-**81***d*, bearing cages **82**, and the like.

The adjustable roll forming stations **44** are arrayed sequentially along either longitudinal side of the bed **72**, for forming flanges in both edges of the web **46**, or otherwise forming or manipulating both edges of the web. (Alternatively, roll forming stations can be arrayed along one side of the bed only, for forming a flange in one side of the web.) In the embodiment of the apparatus shown in FIG. **4**, nine adjustable roll forming stations **44** are provided on each side of the bed **72**, arrayed sequentially one after the other, starting at the infeed end of the apparatus. (Material flow is indicated by arrow "F.") The adjustable roll forming stations **44** are supported at least partly by outer and inner head rails **76***a*, **76***b*, outer and inner upper bearing blocks **80***a*, **80***b*, and outer and inner lower bearing blocks **81***a*, **81***b*. Located downstream of the adjustable roll forming stations **44**, each side of the bed **72** is similarly provided with seven non-adjustable roll forming stations **84**, arrayed sequentially one after the other. The non-adjustable roll forming stations perform finishing or secondary operations for which adjustment is not required, and are supported at least partly by outer and inner head rails **77***a*, **77***b*, outer and inner upper bearing blocks **80***c*, **80***d*, and outer and inner lower bearing blocks **81***c*, **81***d*.

For guiding the web or sheet of material **46** through the flange forming apparatus **40**, the apparatus is outfitted with a conveyor system or assembly **86**. The conveyor system **86** includes at least two primary conveyor drive units **88** (e.g., belts or roller-type mechanisms), which are located on either side of the bed **72**, proximate to the roll forming stations **44**, **84**. The primary conveyor drive units **88** are driven in a standard manner, e.g., using mechanical power originating from a main motor unit **90** and applied through a gear system **92**, for moving the web **46** from the infeed end of the apparatus to the exit or outfeed end of the apparatus. Intermediate rollers or other supports **94** may be provided as part of the conveyor system **86** for supporting the web **46** between the primary conveyor drive units **88**. Additionally, the infeed and outfeed ends of the apparatus may be provided with Stilson-type roll assemblies **96***a*, **96***b*, respectively. (Typically, the conveyor system is used only in a bypass mode, or when the web is not being formed into flanges. It is operable at all times while the machine is running. When the web is being formed into flanges, the rolling action of the roll forming station conveys the web through the apparatus.)

The primary drive system of the flange forming apparatus **40**, for powering the conveyor system **86** and roll forming stations, includes the main drive motor **90**, a reducer **98**, and a drive gear system **100**. The drive motor **90** is a heavy duty AC or DC motor (e.g., 10 hp), which is powered and controlled by a standard motor controller (not shown). The output shaft of the motor **90** is connected to the reducer **98** by way of a flexible coupling **102**. The reducer **98** is used to convert the motor output to a speed/torque range suitable for the drive gear system **100**. A double drive chain **104**, driven by a primary drive sprocket **106** attached to the output of the reducer **98**, extends around an idler unit **108** and one or more secondary drive sprockets **110**. (Two secondary drive sprockets **110** are shown in FIG. **4**, one for each group of roll forming stations.) The secondary drive sprockets **110** each drive a Grob™ spline shaft **112**, which extend across and below the bed **72** and are supported below the lower bearing blocks **81***a*-**81***d* in spline shaft bearing plates **114***a*-**114***d*. For example, as shown in FIG. **10**, the spline shafts **112** may be rotatably supported in the bearing block by way of needle bearing assemblies, thrust bearings, or the like **115**.

The adjustment mechanism **48** includes the adjustment drive unit **50**, which itself includes the drive motor **52** and the screw members **62**, and the adjustment linkage assembly **60**, which comprises a unitary assembly (i.e., the adjustment linkage assembly moves as a unit) of the screw adaptors **65** connected to the bearing support sub-assembly **64**. These components are shown in particular in FIGS. **7**, **8**, and **9**. The adjustment drive unit **50** includes the adjustment drive motor **52** (e.g., a DC gear motor), a primary adjustment drive sprocket **116** attached to the output shaft of the motor **52**, an adjustment drive chain **118**, an idler unit **120**, and a secondary adjustment drive sprocket **122**. The idler unit **120** includes a chain tightener **124**, an idler shaft **126**, and an idler sprocket **128** on the idler shaft **126**. The idler unit **120** is attached to and at least partly supported by a bearing mount and chain tightener support **130**. The adjustment chain **118** is disposed about the drive sprocket **116**, and extends to the idler unit **120** and about the secondary adjustment sprocket **122**. The adjustment gear motor **52** is attached to and supported by a motor mount plate **132**, which is fixedly attached to the outer head rail **76***a* and slidably attached to the inner head rail **76***b* by spool assemblies **134**. The adjustment gear motor **52** is controlled using a standard electric motor controller and control system (not shown).

With reference to FIGS. **7-9** (note that the motor **52** is not shown in FIG. **8**), operation of the adjustment drive motor **52** causes the secondary adjustment sprocket **122** to rotate, which in turn causes one of the screw members **62**, e.g., a shaft-like upper lead screw member **136**, to rotate. At least a fore part of the upper lead screw member **136** is provided with threads **138**. The rest of the lead screw member **136** is optionally unthreaded. The lead screw member **136** is rotatably attached to and supported by the bearing mount and chain tightener support **130**, and also by the adjustment linkage assembly **60**. Carried on the lead screw member **136** are various spacers **140**, for positioning the lead screw member **136**, and a follower adjustment sprocket **142**. Disposed on the threaded portion **138** of the lead screw member **136** are a threaded set collar **144**, which is set back from the end of the threaded portion **138**, and a lock nut assembly or second threaded set collar **146**, which is located proximate to (or at) the end of the threaded portion **138**. One of the screw adaptors **65**, e.g., an upper threaded lead screw adaptor **148**, is also threaded on the lead screw member **136** between the set collar **144** and lock nut assembly **146**. The upper lead screw adaptor **148** is part of the adjustment linkage assembly **60**, which includes the bearing support sub-assembly **64** and the screw adaptors **65** (collectively) connected to the bearing support sub-assembly **64**. The bearing support sub-assembly **64** includes the inner head rail **76***b*, which is optionally outfitted with a stiffening bar **150**, and the inner upper and lower bearing blocks **80***b*, **81***b* attached thereto. The upper lead screw adaptor **148** is attached to the inner head rail **76***b*.

A lower lead screw member **152**, lying parallel to and generally below the upper lead screw member **136** in the area of the lower bearing blocks **81***a*, **81***b*, is rotatably attached to and supported by the outer lower bearing block **81***a* or otherwise. Like the upper lead screw member **136**, the lower lead screw member **152** includes a fore threaded portion. A lower lead screw adaptor **154** (again, part of the adjustment linkage assembly **60**) is threaded on the lower lead screw adaptor **152**, and attached to the lower inner bearing block **81***b*. A lower lead screw sprocket **156** is attached to the lower lead screw member **152** in alignment with the follower adjustment sprocket **142** attached to the upper lead screw member **136**. The lower lead screw sprocket **156** and the follower adjustment sprocket **142** are interconnected by an adjustment chain **158**, which also extends around similar screw members **62** at one or more of the other roll forming stations **44**. For example, as shown in FIG. **8**, the block of adjustable roll forming stations **44** includes four screw members **62**: the upper and lower lead screw members **136**, **152**, located generally towards the outfeed end of the stations **44**, and upper and lower secondary screw members **160**, **162** located at the infeed end of the stations **44**. Each screw member **62** is outfitted with a sprocket, and the sprockets are interconnected by the adjustment chain **158**.

Whereas the outer bearing blocks **80***a*, **81***a* and head rail **76***a* are fixed in place, at least in relation to the adjustment mechanism **48** portion of the flange forming apparatus **40**, the inner head rail **76***b*, bearing blocks **80***b*, **81***b*, and screw adaptors **148**, **154** (which are interconnected to one another to form the adjustment linkage assembly **60**) float together as a unit, and are moveable towards and away from the outer bearing blocks. The assembly **60** is supported and kept in vertical alignment by the screw members **62**, by the roll forming pairs **54***a*, **54***b* (as discussed in more detail below), and through attachment of the lower inner bearing block **81***b* to an inner one of the spline shaft bearing plates **114***b*, which is in turn supported by the spline shaft **112**. (Alternatively or in addition, the assembly **64** can be slidably supported on frame members located below the assembly.) The position of the adjustment linkage assembly **60** is established by the screw members **62**. In particular, when the adjustment motor **52** is controlled to rotate the upper lead screw member **136** in one direction, the other screw members are concurrently similarly rotated, by way of the sprockets **142**, **156** and chain **158** interconnection. As the screw members **62** rotate, the screw adaptors **65**, threaded on the screw members, are caused to move along the screw members in one direction, thereby shifting the rest of the assembly **60** in the same direction. The screw adaptors **65** are prevented from rotating along with the screw members **62** by virtue of their connection to the rest of the assembly **60**, which is constrained through its connection to the roll forming pairs **54***a*, **54***b*. When the adjustment motor **52** is controlled to rotate the upper lead screw member **136** in the other direction, the screw adaptors and other portions of the assembly **60** are shifted in the other direction.

As mentioned above, and momentarily referring back to FIG. **7**, the motor mount plate **132** is fixedly attached to the outer head rail **76***a* but slidably attached to the inner head rail **76***b* by the spool assemblies **134**. This is because the inner head rail **76***b* shifts along with the rest of the adjustment linkage assembly **60** during actuation of the adjustment drive unit **50**.

Each roll forming pair **54***a*, **54***b* is supported on a rotatable roller die spindle **164***a*, **164***b*, respectively. The upper spindle **164***a* is rotatably supported by the upper bearing blocks. More specifically, the upper spindle **164***a* extends through (i) an aperture in the outer upper bearing block **80***a*, which is outfitted with a bearing **166**, and (ii) through an aperture in the inner upper bearing block **80***b*, which is outfitted with a needle-type bearing assembly **168**. An upper spindle gear **170** is fixedly attached to the upper spindle **164***a* just inside the outer upper bearing block **80***a*. The upper spindle **164***a* is kept in place axially by an outer washer or retainer assembly **172**, located on the outer side of the outer upper bearing block **80***a*, and a C-ring assembly **174** abutting the inner side of the spindle gear **170**. The lower spindle **164***b*, outfitted with a lower spindle gear **176**, is similarly supported in the outer and inner lower bearing blocks **81***a*, **81***b*.

With reference to FIG. **9**, the first roll forming portion **56** of the upper roll forming pair **54***a* (e.g., one part of a split roll forming die) is fixedly attached to a first end of the upper spindle **164***a*, distal from the second end of the spindle that is rotatably supported by the outer upper bearing block **80***a*. The first roll forming portion **56** rotates along with the spindle **164***a*, and is prevented from moving axially along the spindle **164***a*. The second roll forming portion **58** is also attached to the spindle **164***a*, but closer to the second end of the spindle, to one side of the first roll forming portion **56**. The second roll forming portion **58** rotates along with the spindle **164***a*. Additionally, the second roll forming portion **58** is slidable along a portion of the length of the spindle **164***a*. For allowing the second roll forming portion **58** to slide along and rotate with the spindle **164***a*, a key- or spline-type connection may be used between the spindle and second roll forming portion. In the case of a key-type connection **178**, the spindle **164***a* is provided with one or more axially oriented keys **178***a* attached thereto. The central aperture of the second roll forming portion **58**, through which the spindle extends, is provided with one or more radially extending keys slots **178***b*, which are configured to accommodate the keys attached to the spindle. The key slots are longer than the keys, allowing the second roll forming portion **58** to move axially along the spindle. When the spindle **164***a* is rotated, the spindle keys interact with the side walls of the key slots formed in the second roll forming portion, thereby rotating the second roll forming portion **58** along with the spindle.

In one embodiment, as shown in FIG. **9**, the key slot(s) **178***b* formed in the second roll forming portion **58** extends along the entire longitudinal length of the second roll forming portion. Here, the key slot allows for (i) the second roll forming portion to slide along the spindle and (ii) the spindle to rotate the second roll forming portion, but the key/key slot interaction does not act as a limiting factor in terms of the extent to which the second roll forming portion can move along the spindle.

As should be appreciated, in regards to a key-type connection **178** between the spindle and second roll forming portion, either element may be outfitted with one or more keys and the other element outfitted with a corresponding number of key slots.

In addition to the part that acts as a roll forming die, the second roll forming portion **58** includes an integral neck member **180**. The neck member **180** is concentrically disposed between the spindle **164***a* and the needle bearing assembly **168**. The neck member **180** is free to rotate within the needle bearing assembly **168**. Thereby, the entire second roll forming portion **58** is rotatably supported by the needle bearing assembly **168** and rotatable with respect to the adjustment linkage assembly **60**. Additionally, the second roll forming portion **58** is maintained in the needle bearing assembly **168** by a retaining ring and thrust race assembly **182**. In this manner, thereby: (i) the second roll forming portion **58** is rotated by the spindle **164***a*; (ii) the second roll forming portion **58** and spindle **164***a* are rotatably supported by the needle bearing assembly **168**, which is carried in the bearing support sub-assembly portion of the adjustment linkage assembly; (iii) the second roll forming portion **58** can be slid axially along a portion of the spindle **164***a*; and (iv) the second roll forming portion **58** is rotatably connected to the needle bearing assembly **168** bearing support sub-assembly **64**, such that the axial position of the second roll forming portion **58** along the spindle **164***a* is established by the adjustment linkage assembly **60**, i.e., when the adjustment linkage assembly **60** is shifted left or right, the second roll forming portion **58** moves along therewith, along the spindle **164***a*. Because the first roll forming portion **56** is axially stationary, this changes the distance "D" between the first and second roll forming portions **56**, **58**.

The lower roll forming pair **54***b* and the lower roller die spindle **164***b* are configured similarly to the upper roll forming pair **54***a* and upper roller die spindle **164***a*, as described above, e.g., the second roll forming portion **58** of the lower roll forming pair **54***b* moves towards or away from the first roll forming portion **56** when the adjustment linkage assembly **60** is shifted laterally.

The range "R" through which the adjustment linkage assembly **60** may be shifted is defined by several elements. These include the threaded set collar **144** and lock nut assembly **146** on the upper lead screw member **136** (the threaded set collar **144** sets the absolute maximum, the lock nut assembly the absolute minimum), the length of possible travel of the second roll forming portions **58** along the spindles **164***a*, **164***b* (e.g., defined by the length of the key slot), and the first roll forming portions **56** at the ends of the spindles **164***a*, **164***b*. In the embodiment shown in FIG. **9**, the absolute minimum "R**1**" (for the overall apparatus) is defined by the positioning of the first roll forming portions **56**, and the absolute maximum "R2" is defined by the length of the key slot in the second roll forming portion(s). In other words, the minimum possible distance between the two roll forming portions is when the second portion abuts the first portion, and the maximum possible distance between the two is defined by how far the second roll forming portion can move along the spindle away from the first roll forming portion. Within this maximum range, the actual range of travel can be adjusted by changing the positions of the threaded set collar **144** (which may be adjusted to set the actual maximum R**2**) and the lock nut assembly **146** (which may be adjusted to set the actual minimum R**1**). Of course, if the set collar or lock nut assembly are positioned outside the absolute maximum or minimum range, then the actual range is established by other limiting elements, e.g., the key slots or first roll forming portions. Also, motorized movement may be limited by using adjustable limit switches or sensors setting R**2** and R**1**.

For carrying out forming operations on a web **46**, for a single station **44**, it is typically the case that the web is conveyed between the upper roll forming pair **54***a* and the lower roll forming pair **54***b*, each of which acts as a roll forming die, and which are set to rotate at a particular speed. (Although industry parlance sometimes characterizes a roll forming "pair" as being an upper roll forming die in conjunction with a lower roll forming die, in the present application the term "pair" is used in a slightly different sense, to refer to the two parts **56**, **58** of an adjustable, split roll forming die.) The roll forming pairs **54***a*, **54***b* are aligned axially and offset laterally (e.g., the two pairs are laterally or radially adjacent), and are shaped in a standard, complementary manner depending on the roll forming operation to be carried out. For driving the roll forming pairs **54***a*, **54***b*, the spline shaft **112** is rotated (see FIG. **4** and accompanying description above), which in turn causes a spline gear **184** attached to the spline shaft **112** to rotate. The spline gear **184**, aligned with the lower spindle gear **176**, causes the lower spindle gear **176** to rotate, either directly by being meshed therewith, or indirectly through an idler gear **186** carried on an idler shaft **188**. Rotation of the lower spindle gear **176** causes the lower spindle **164***b* and lower roll forming pair **54***b* to rotate. Meshed with the upper spindle gear **170**, rotation of the lower spindle gear **176** also causes the upper spindle gear **170** to rotate, which rotates the upper spindle **164***a* and upper roll forming pair **54***a*.

FIG. **10** shows one of the non-adjustable roll forming stations **84** in cross section. Each station **84** includes upper and lower roller dies **190***a*, **190***b*, which are disposed on upper and lower spindles **192***a*, **192***b*, respectively. The spindles extend between and are rotatably supported by the bearing blocks. Rotation of the spindles **192***a*, **192***b* is carried out through a gear system, e.g., gears **184**, **186**, **176**, and **170**, similarly to as explained above in regards to FIG. **9**.

To summarize operation of the adjustment mechanism **48**, for changing the distance "D" between the first and second roll forming portions **56**, **58** of the roll forming pairs **54***a*, **54***b* in all the adjustable stations **44** concurrently, the adjustment drive unit **50** is actuated in a standard manner to rotate the upper lead screw member **136** in a desired direction. (Operation of the drive unit for rotation of the upper lead screw member in one direction causes the first and second roll forming portions to move closer together, and operation of the drive unit for rotation of the upper lead screw member in the other direction causes the first and second roll forming portions to move farther apart.) As the upper lead screw member **136** rotates, this causes the follower adjustment sprocket **142** to rotate, pulling the adjustment chain **158**. Since the adjustment chain **158** interconnects the plurality of screw members **62** (see, e.g., FIG. **8**), this causes all of the screw members **62** to rotate in concert. Each screw member **62** is outfitted with a screw adaptor **65** threaded thereon. The screw adaptors are in turn connected to the rest of the adjustment linkage assembly **60**, e.g., to the bearing support sub-assembly **64**, which includes the upper and lower inner bearing blocks **80***b*, **81***b*, various posts **78**, the inner head rail **76***b*, etc. Thus, when the screw members **62** are caused to rotate, the screw adaptors **65** are caused to move along the screw members, shifting the adjustment linkage assembly **60** in the desired direction. Since the second roll forming portions **58** of all the stations **44** are rotatably connected to the bearing support sub-assembly **64** (and thereby to the adjustment linkage assembly **60** as a whole), whereas the first roll forming portions **56** and spindles **164***a*, **164***b* are axially stationary (at least in the context of the adjustment mechanism **48**), shifting of the adjustment linkage assembly **60** causes the second roll forming portions **58** to concurrently move towards or away from the first roll forming portions **56**, for all the stations **44**.

Subsequent to adjustment, the spline shaft **112** is actuated, actuating the gear system **184**, **186**, **176**, **170**, and causing the roll forming pairs **54***a*, **54***b* to rotate. The roll forming stations **44** are firmly supported by the inner and outer bearing blocks (and related elements), and the adjustment linkage assembly **60** is prevented from moving axially because of the screw members **62**, i.e., rotation of the screw members causes the screw adaptors to shift position, but vibration in the screw adaptors does not cause them to move along the screw members, due to the threaded connection between the screw members and screw adaptors. Next, or possibly concurrently, the conveyor system **86** is actuated, if necessary, and a web of metal or other material **46** is fed into the apparatus **40**. The web **46** is conveyed through the apparatus **40**, where it is roll formed by the stations **44**, **84** to form a flange **22** therein. The finished web **66**, now outfitted with one or more flanges **22**, exits the apparatus **40**. (As noted above, it is typically the case that the conveyor system is only used to convey the web in a bypass mode, with the roll forming stations pulling the web through the apparatus when flanges are to be formed.)

The adjustment mechanism **48** may include a position scale (not shown) that shows a user what flange height "H" will be produced by the flange forming apparatus according to its current state of adjustment. When the adjustment mechanism is actuated for adjusting the stations **44**, the position scale shows the corresponding, newly adjusted flange height. Additionally, if the apparatus utilizes an adjustment motor **52** as part of the adjustment drive unit **50**, the controller for controlling the motor can be provided with an electronic control sub-system that would enable a user to select or enter different flange heights, with the control sub-system causing the motor to be controlled to adjust the stations **44** to effectuate the designated flange height.

The flange forming apparatus **40** also includes a mechanism for adjusting the overall width of the bed **72**, within predetermined limits, for accommodating different sized sheets of material. The width adjustment system is shown in FIGS. **3**A, **3**B, and **5**. In one embodiment, the apparatus **40** is designed to process a web of material that can be between 36 inches and 72 inches wide (91-182 cm). The position of the two roll forming heads can be adjusted using the hand cranks **194** shown in FIGS. **3**A and **5**. Rotating one hand crank will move the near (or operator side) head into position with the web. Rotating the other hand crank will move the far (or guide side) head into position with the web. The hand cranks **194** are also used to move the heads out of position when forming of the web is not required. In this position the web will move through the machine on the conveyor without flanges being formed. The chain mechanism **196** in FIG. **3**B connects the pair of lead screws to the single hand crank, in each case.

FIG. **6** shows a mounting plate assembly **198**, which supports various limit switches that control the adjustment drive motor **52**, e.g., the limit switches may be used to ensure that the motor does not attempt to cause the adjustment linkage assembly **60** to move past set boundaries. (See also FIG. **7**.) The assembly **198** includes a plate mount **200**, a limit switch trip **202**, a roller type micro switch **204**, a limit switch mount **206**, and a limit switch head rail mount **208**.

If the flange forming apparatus is provided with adjustable roll forming stations **44** on both sides of the main bed, each side will typically be provided with its own adjustment mechanism **48**. The adjustable stations may be controlled all together, or on a side-by-side basis.

An embodiment of the present invention may be characterized as including: a support frame; a plurality of adjustable roll forming means (stations **44**) attached to the support frame for forming a flange in a sheet of material **46**; and adjustment means (adjustment drive unit **50**, including a motor **52** or hand crank and screw members **62** rotated thereby, adjustment linkage assembly **60**, including the screw adaptors **65** and the bearing support sub-assembly **64**, and related elements) attached to the support frame and operably interfaced with the plurality of adjustable roll forming means for adjusting the roll forming means concurrently together, e.g., the adjustment linkage assembly, positioned by the screw members, rotatably supports and positions the second roll forming portions **58**.

Although the flange forming apparatus has been illustrated as utilizing an adjustment gear motor **52**, an adjustment hand crank could be used instead without departing from the spirit and scope of the invention. Thus, the adjustment drive unit **50** can includes hand cranks, motors, and similar components, along with the supporting accoutrement there for.

As should be appreciated, although the roll forming stations have been generally illustrated as included two roll forming pairs, each with first and second roll forming portions, e.g., roll forming dies, the present invention contemplates that the stations in some instances could instead include only one roll forming pair, or more than two roll forming pairs, with or without additional roll forming elements, such as non-adjustable roll forming dies or the like.

As should be appreciated, in addition to the upper lead screw member having a threaded set collar and/or lock nut assembly, the other screw members may be provided with similar components.

As indicated above, the flange forming apparatus can be used to form different types of flanges, including TDC® and TDF® flanges. To configure the apparatus for producing a particular type of flange, the roll forming stations are outfitted with the appropriate types of roll forming dies for the flange in question.

Since certain changes may be made in the above-described adjustable flange forming apparatus, without departing from the spirit and scope of the invention herein involved, it is intended that all of the subject matter of the above description or shown in the accompanying drawings shall be interpreted merely as examples illustrating the inventive concept herein and shall not be construed as limiting the invention.

What is claimed is:

1. A flange forming apparatus comprising:

a support frame;

a bed positioned atop the support frame, said bed having a width;

a plurality of roll forming stations attached to the support frame along either or both longitudinal sides of said bed for forming a flange in a sheet of material, wherein each of the stations is adjustable in regards to a dimensional characteristic of the transverse flange to be produced or operated upon by the station;

first inner and outer head rails disposed along a longitudinal side of said bed;

second inner and outer head rails disposed along another longitudinal side of said bed, said first and said second inner and outer head rails supporting said plurality of roll forming stations;

a flange height adjustment mechanism attached to the support frame, said adjustment mechanism being operably connected to the plurality of roll forming stations for adjusting the roll forming stations concurrently together in said regards to a dimensional characteristic of the transverse flange to be produced; and

a bed-width adjustment mechanism including a first hand wheel positioned along one of said longitudinal side of said bed, first lead screws and a first chain mechanism for connecting the first lead screws to the first hand wheel for adjusting a position of said first inner head rail upon rotation of said first hand wheel to concurrently adjust a position of all of said plurality of roll forming stations supported by said first inner head rail in relation to said second inner head rail, and a second hand wheel positioned along the same longitudinal side of said bed as said first hand wheel, second lead screws and a second chain mechanism for connecting the second lead screws to the second hand wheel for adjusting a position of said second inner head rail upon rotation of said second hand wheel to concurrently adjust a position of all of said plurality of roll forming stations supported by said second inner head rail in relation to said first inner head rail, for adjusting said width of said bed for accommodating different sized sheets of material.

2. The flange forming apparatus of claim **1**, wherein:

the roll forming stations are infinitely adjustable within a set range defined by maximum and minimum values for the flange dimensional characteristics.

3. The flange forming apparatus of claim **2**, wherein, for each of said stations, the dimensional characteristic is a height of the flange.

4. The flange forming apparatus of claim **2**, wherein:

each roll forming station includes at least one roll forming pair, said pair comprising first and second coaxial roll forming portions, said second roll forming portion being axially moveable towards and away from the first roll forming portion; and

the flange height adjustment mechanism includes:

an adjustment drive unit; and

an adjustment linkage assembly operably connected to the drive unit and to the second roll forming portions, said adjustment linkage assembly establishing respective axial positions of the second roll forming portions, wherein for each roll forming pair, operation of the drive unit causes the adjustment linkage assembly to change the axial position of the second roll forming portion with respect to the first roll forming portion and, thereby, a distance there between, said distance corresponding at least in part to the dimensional characteristic of the flange to be produced or operated upon by the station.

5. The flange forming apparatus of claim **4**, wherein:

the adjustment drive unit includes a rotatably driven screw member; and

the adjustment linkage assembly includes a bearing support assembly and a screw adaptor attached thereto and threaded on to the screw member, said bearing support assembly being operably interfaced with the second roll forming portions of the roll forming pairs for establishing the axial position thereof;

wherein actuation of the adjustment drive unit causes the screw member to rotate and the screw adaptor to move along the screw member, thereby shifting the bearing support assembly and changing the axial position of each second roll forming portion and the distance between it and its respective first roll forming portion.

6. The flange forming apparatus of claim **4**, wherein:

the adjustment drive unit includes a plurality of rotatably driven screw members; and

the adjustment linkage assembly includes a bearing support assembly and a plurality of screw adaptors attached thereto and respectively threaded on the screw members, said bearing support assembly being operably interfaced with the second roll forming portions for establishing the axial positions thereof;

wherein operation of the adjustment drive unit causes the screw members to rotate and the screw adaptors to respectively move along the screw members, thereby shifting the bearing support assembly and changing the axial positions of the second roll forming portions and the distances between them and respective first roll forming portions.

7. The flange forming apparatus of claim **6**, wherein the screw members are interconnected by a chain drive, such that rotation of one of the screw members or the chain drive by a motor or hand crank portion of the adjustment drive unit causes all of said plurality of screw members to rotate in concert.

8. The flange forming apparatus of claim **7**, wherein the adjustment drive unit comprises the motor, a sprocket connected to one of the screw members or to the chain drive, and a motor chain interconnecting the motor and sprocket.

9. The flange forming apparatus of claim **4**, wherein the first and second roll forming portions of each roll forming pair are supported on and rotatably driven by a spindle, said first roll forming portion being fixed on the spindle and said second roll forming portion being axially moveable along the spindle.

10. The flange forming apparatus of claim **9**, wherein:

the spindle includes an axially-oriented key slot formed therein;

the second roll forming portion is slidably attached to the spindle within the key slot, wherein rotation of the spindle causes the second roll forming portion to rotate through interaction of the key slot and second roll forming portion; and

the spindle and the second roll forming portion extend through, and are rotatably supported by, a bearing carried in a bearing support assembly portion of the adjustment linkage assembly, said bearing support assembly establishing the position of the second roll forming portion along the key slot and thereby the distance between the second roll forming portion and its respective first roll forming portion attached to the spindle.

11. The flange forming apparatus of claim **2** wherein:

each roll forming station includes at least one roll forming pair, said roll forming pair comprising:

a first roll forming portion fixedly attached to a rotatable spindle, said first roll forming portion and said spindle being non-axially moveable with respect to one another; and

a second roll forming portion attached to the spindle and coaxial with the first roll forming portion, said spindle being drivable to rotate the first and second roll forming portions, wherein the second roll forming portion is axially moveable along the spindle for adjustment of a distance between the first and second roll forming portions, said distance corresponding at least in part to the dimensional characteristic of the flange to be produced or operated upon by the station; and

the flange height adjustment mechanism comprises:

an adjustment drive unit having a plurality of screw members configured for rotation by a motor or hand crank; and

an adjustment linkage assembly comprising:

a bearing support assembly; and a plurality of screw adaptors attached to the bearing support assembly and respectively threaded on the screw members, said bearing support assembly rotatably supporting the spindle of the roll forming pair and being operably interfaced with the second roll forming portion of the roll forming pair for establishing an axial position of the second roll forming portion along the spindle;

wherein rotation of the screw members causes the screw adaptors to axially move along the screw members, said adaptors being prevented from rotation due to their attachment to the bearing support assembly, thereby shifting the axial positions of the second roll forming portions for adjusting respective distances between the second roll forming portions and the first roll forming portions.

12. The flange forming apparatus of claim **11** wherein:

the plurality of adjustable roll forming stations are sequentially arrayed along the support frame in a first unitary group; and

the apparatus further comprises a plurality of non-concurrently adjustable roll forming stations sequentially arrayed along the support frame in a second unitary group, said adjustable and non-adjustable stations performing sequential operations on the sheet of material for forming a flange therein.

13. The flange forming apparatus of claim **12** wherein:

each roll forming station includes two of said roll forming pairs, a first one of said pairs being located generally above a second one of said pairs, and said first and second pairs being axially aligned and laterally adjacent to one another;

each of said roll forming pairs is a roll forming die, the first and second pairs being complementary in shape to one another for performing a roll forming operation on the sheet of material;

the roll forming pair spindles are attached to and rotatably supported by a fixed bearing block assembly attached to the support frame;

all the second roll forming portions of the roll forming pairs in the sequential array of adjustable roll forming stations are rotatably attached to the bearing support assembly portion of the adjustment linkage assembly, said bearing support assembly including: bearings for rotatably supporting the spindles and second roll forming portions; and one or more bearing blocks holding the bearings, said adjustment linkage assembly extending generally the length of the sequential array of adjustable roll forming stations and being moveable as a unit; and

the screw members are threaded through the screw adaptors of the adjustment linkage assembly, wherein rotation of the screw members upon actuation of the adjustment drive unit causes the adjustment linkage assembly to move towards or away from the fixed bearing block assembly and all the second roll forming portions to move away or towards the first roll forming portions.

14. A flange forming apparatus comprising:

a support frame;

a bed positioned atop the support frame, said bed having a width;

a plurality of adjustable roll forming means attached to the support frame along either or both longitudinal sides of said bed for forming a flange in a sheet of material;

first inner and outer head rails disposed along a longitudinal side of said bed;

second inner and outer head rails disposed along another longitudinal side of said bed, said first and said second inner and outer head rails supporting said plurality of adjustable roll forming means;

adjustment means attached to the support frame and operably interfaced with the plurality of adjustable roll forming means for adjusting the roll forming means concurrently together in regards to a dimensional characteristic of the transverse flange to be produced; and

a bed-width adjustment mechanism including a first hand wheel positioned along one of said longitudinal side of said bed, first lead screws and a first chain mechanism for connecting the first lead screws to the first hand wheel for adjusting a position of said first inner head rail upon rotation of said first hand wheel to concurrently adjust a position of all of said plurality of roll forming stations supported by said first inner head rail in relation to said second inner head rail, and a second hand wheel positioned along the same longitudinal side of said bed as said first hand wheel, second lead screws and a second chain mechanism for connecting the second lead screws to the second hand wheel for adjusting a position of said second inner head rail upon rotation of said second hand wheel to concurrently adjust a position of all of said plurality of roll forming stations supported by said second inner head rail in relation to said first inner head rail, for adjusting said width of said bed for accommodating different sized sheets of material.

15. A flange forming apparatus comprising:

a support frame;

a bed positioned atop the support frame, said bed having a width;

at least one roll forming station attached to the support frame along either or both longitudinal sides of said bed for at least partially forming a flange in a sheet of material moving through the apparatus, said station comprising first and second rotatable spindles, each of said spindles carrying: a first roll forming portion fixedly attached to the spindle for rotation thereby; and a second roll forming portion attached to the spindle for rotation thereby and coaxial with the first roll forming portion, said second roll forming portion being moveable along the spindle for adjustment of a distance between the first and second roll forming portions, said distance relating to a height of the flange produced by the apparatus;

first inner and outer head rails disposed along a longitudinal side of said bed;

second inner and outer head rails disposed along another longitudinal side of said bed, said first and said second inner and outer head rails supporting said plurality of roll forming stations;

an adjustment mechanism attached to the support frame, said adjustment mechanism rotatably supporting the spindles and establishing, for each spindle, the position of the second roll forming portion along the spindle and thereby the distance between the first and second roll forming portions; and

wherein operation of the adjustment mechanism causes the second roll forming portions to concurrently move along their respective spindles, for concurrent adjustment of the distances between the first and second roll forming portions and thereby the height of the flange to be produced by the apparatus

a bed-width adjustment mechanism including a first hand wheel positioned along one of said longitudinal side of said bed, first lead screws and a first chain mechanism for connecting the first lead screws to the first hand wheel for adjusting a position of said first inner head rail upon rotation of said first hand wheel to concurrently adjust a position of all of said plurality of roll forming stations supported by said first inner head rail in relation to said second inner head rail, and a second hand wheel positioned along the same longitudinal side of said bed as said first hand wheel, second lead screws and a second chain mechanism for connecting the second lead screws to the second hand wheel for adjusting a position of said second inner head rail upon rotation of said second hand wheel to concurrently adjust a position of all of said plurality of roll forming stations supported by said second inner head rail in relation to said first inner head rail, for adjusting said width of said bed for accommodating different sized sheets of material.

16. The flange forming apparatus of claim **15** wherein:

the spindles are parallel to one another; and

the first and second roll forming portions of the first spindle are axially aligned with and laterally spaced apart from the first and second roll forming portions of the second spindle, respectively, said first roll forming portions and said second roll forming portions respectively cooperating for at least partially forming the flange in the sheet of material.

17. The flange forming apparatus of claim **16** wherein the adjustment mechanism includes:

an adjustment drive unit having a motor or hand crank and at least one screw member rotatably driven by said motor or hand crank; and

an adjustment linkage assembly having at least one screw adaptor threaded on the at least one screw member, said adjustment linkage assembly rotatably supporting the roll forming station,

wherein operation of the adjustment drive unit causes the at least one screw member to rotate and the at least one screw adaptor to move along the at least one screw member, for shifting the adjustment linkage assembly as a whole and thereby adjusting the roll forming station.

18. The flange forming apparatus of claim **17** wherein the adjustment drive unit includes a plurality of screw members, and the adjustment linkage assembly includes a plurality of screw adaptors respectively threaded on the screw members, said screw members being interconnected by a chain drive, wherein rotation of one of the screw members by the motor or hand crank causes all of the screw members to rotate in concert.

19. The flange forming apparatus of claim **18** wherein:

the flange forming apparatus includes a plurality of said roll forming stations; and

operation of the adjustment drive unit causes the roll forming stations to be adjusted concurrently, for movement of the second roll forming portions carried on the spindles towards or away from the first roll forming portions.

20. The flange forming apparatus of claim **15** wherein for each spindle, the distance between the first and second roll forming portions is infinitely adjustable within predetermined minimum and maximum limits.

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